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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 167 320**
B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **16.08.89**

(51) Int. Cl.[4]: **F 16 C 9/00,** F 16 C 33/14

(21) Application number: **85304298.4**

(22) Date of filing: **17.06.85**

2 Teile 1. Satz
2. Lagerteil 1. Satz
3. Teile 2. Satz

(54) Method of making a split bearing assembly.

(30) Priority: **02.07.84 US 627028**

(43) Date of publication of application:
08.01.86 Bulletin 86/02

(45) Publication of the grant of the patent:
16.08.89 Bulletin 89/33

(84) Designated Contracting States:
DE FR GB IT

(56) References cited:
DE-A-1 575 383
FR-A-2 526 698
US-A-2 553 935
US-A-3 818 577
US-A-3 994 054

PATENT ABSTRACTS OF JAPAN, vol. 7, no. 98 (M-210)1243r, 26th April 1983; & JP - A - 58 21017 (YAMAHA HATSUDOKI K.K.) 07-02-1983

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EP 0 167 320 B1

Courier Press, Leamington Spa, England.

Description

This invention relates to a method of making a split bearing assembly as specified in the preamble of claim 1, for example as disclosed in US—A—2 553 935.

It is known in the mechanical arts to provide split bearing assemblies in various structural and machine components for supporting, or being supported by, the journals of rotating shafts and the like. Examples of applications for split bearing assemblies include engine crankshaft main and connecting rod bearing assemblies, some camshaft bearing assemblies, crank-supporting bearing assemblies for compressors, presses and other machines, and other rotatable shaft-supporting bearing assemblies, in all of which a removable saddle-like bearing cap is secured to a mating saddle-like main body to provide for the installation and removal of a rotatable shaft or an attached connecting rod, for example.

Undoubtedly the most common method for manufacturing the separable main bodies and caps of split bearing assemblies is to form them separately by casting, forging or otherwise, whether they be for connecting rods, engine crankcases or other devices, and to subsequently bolt or otherwise secure together the caps and the main bodies. In many cases, finish machining of the journal-encircling opening is completed after initial assembly of these components. This manufacturing method requires a large number of machining operations, as well as preliminary assembly and disassembly of the components, before the supporting or supported shaft may be installed.

Another known manufacturing method involves initially forming the main body and cap integrally, and then separating them during manufacture by sawing or cutting away excess material provided to initially joint the components. This method also requires machining of the connecting surfaces and other portions, generally including preliminary assembly.

In the case particularly of connecting rods, the prior art teaches other methods of forming the main body and cap as integral members and completely machining all necessary surfaces, including the journal-encircling opening or bore, before separating the main body and cap members. The members are separated by material fracture techniques which involve fracturing the components along predetermined fracture planes, leaving interlocking rough surfaces that are capable of being re-engaged for assembly of the components into an operating assembly.

The prior-art fracture techniques, which are exemplified by the disclosures of the said US—A—2 553 935 and of US—A—3 994 054, include various methods of weakening the separation planes, such as by drilling holes therein and/or providing weakening notches along one or more edges. Embrittlement of the material in the separating planes may also be provided for (US—A—3818577) by material selection or heat treatment (including hardening of various types), or by freezing the material to reduce its temperature to below the embrittlement point.

The various types of prior fracture techniques introduce various problems, among which are reduction of the engageable surface are of the separated parts, so reducing the allowable clamping load, and in some cases the introduction of excessive bending of the separating parts, which results in yielding deformation of metal along the edges that interferes with proper re-assembly of the separated components. Deformation of the previously machined opening can also be a problem with some methods. Such difficulties limit the usable applications of fracture techniques, and sometimes require additional machining operations to clean up or correct the effects of deformation and yielding.

The present invention is concerned with a method of making a split bearing assembly which substantially reduces the amount of machining as compared with the most common methods, and which utilizes a novel fracture technique that eliminates problems of bending deformation during fracture as well as avoiding the necessity for additional machining after separation.

To this end a method of making a split bearing assembly in accordance with the present invention is characterised by the features specified in the characterising portion of claim 1.

This two-step fracture method including clamping the first legs together after fracture and then fracturing the second legs reduces bending distortion at the outer edge of the fractured second legs.

The method in accordance with the invention is applicable not only to connecting rods and similar items to which fracture separation has previously been applied, but also to components having a plurality of bearing caps connected to a single body, such as an engine block.

A novel form of splitting apparatus may be utilised in the method for the manufacture of engine blocks and the like.

In the drawings:

Figure 1 is an elevational view of the crankpin-encircling end of a connecting rod, forming a split bearing assembly made by a method in accordance with the present invention;

Figure 2 is a longitudinal cross-sectional view from the plane indicated by the line 2—2 of Figure 1, showing the interior of a bearing bore;

Figure 3 is a fragmentary transverse cross-sectional view from the plane indicated by the line 3—3 of Figure 2, showing cap securing means;

Figures 4 and 5 are fragmentary elevational views showing the results of sequential fracture separation steps of a method in accordance with the present invention;

Figure 6 is a pictorial view illustrating a known form of apparatus for performing fracture separation;

Figure 7 is a fragmentary end view of the crankshaft-carrying portion of an engine block,

including attached main bearing caps, made by a method in accordance with the present invention;

Figure 8 is a partial sectional view from the plane indicated by the line 8—8 of Figure 7, showing a number of bearing bores;

Figure 9 is a fragmentary sectional view from the plane indicated by the line 9—9 of Figure 8, showing securing means;

Figures 10 and 11 are fragmentary pictorial views of one of a number of crankcase webs before and after the fracture separation steps of a method in accordance with the present invention;

Figures 12 and 12A are fragmentary cross-sectional views through alternative embodiments of split bearing assemblies suitable for supporting crankshaft main journals and made by a method in accordance with the present invention;

Figure 13 is a side view showing a novel ganged splitting tool providing a splitting die for use in simultaneous fracture separation of multiple main bearing caps from their associated bodies by a method in accordance with the present invention; and

Figure 14 is a cross-sectional view from the plane indicated by the line 14—14 of Figure 13, showing the splitting die construction.

With reference now to the drawings, Figures 1 to 3 illustrate the crankpin-encircling large end of a connecting rod assembly generally indicated by reference numeral 20, and of the type for use in internal combustion engines, for example. The connecting rod 20 includes a saddle-like main body 21 which is bifurcated to form first and second legs 22 and 24 respectively and a removable saddle-like bearing cap 25 that is also bifurcated to define first and second legs 26 and 28 respectively. The first legs 22 and 26 of the body and cap have mating ends 29 and 30 respectively, and the second legs 24 and 28 of the body and cap have mating ends 32 and 33 respectively.

The mating ends 29, 30 and 32, 33 are secured in end-to-end engagement so that the saddle-like members 21 and 25 define a journal-receiving opening 34 in which a crank pin journal, not shown, may be received. Commonly, split-insert bearing shells, not shown, are clamped within the journal-receiving opening 34 to provide a suitable bearing surface for relative rotation of the crank pin, not shown, within the connecting rod.

As shown, the bifurcated legs 22, 24, 26, 28 of the body and cap incorporate integral bolt bosses through which bolt openings 36 extend from the distal end of the cap legs 26, 28 through the mating ends 29, 30, 32, 33 and into the legs 22, 24 of the body to receive body bolts 37 that threadably engage the legs 22, 24 of the body and secure the legs 26, 28 of the cap in engagement therewith.

The mating ends 29, 30 and 32, 33 of the legs of the cap and body comprise rough, uneven mating surfaces formed by a fracture separation method to be subsequently described, and lying generally along split planes, 38, 39 located on opposite sides of the opening 34. In the present instance the split planes lie on a common transverse diametral plane passing through the axis 40 of the journal-receiving opening 34 and at right angles to the main longitudinal axis 41 of the connecting rod. It would be possible, however, to form the split planes 38, 39 outside, or at an oblique angle to, the diametral plane. At the inner edges of the mating ends, along the split planes 38, 39, notches 42, 44 are formed in the periphery of and extending longitudinally for the length of the cylindrical opening 34, to initiate and locate the starting points of separation in the subsequent fracture steps and form the inner edges of the mating legs of the cap and body. The cap may be formed of any appropriate material, such as cast iron, steel or aluminium.

The steps in a preferred form of the method in accordance with the invention, for manufacturing the connecting rod assembly of Figures 1 to 3 are as follows. An integral unfinished connecting rod 20, including unseparated body and cap portions 21 and 25 respectively, with a pin-encircling (journal-receiving) opening defined thereby, is first formed in any suitable manner, such as by casting or forging. The integral rod is then machined to its finished dimensions by machining the bore 34, drilling and threading the bolt openings 36, and finishing the opposite sides of the connecting rod at the ends of the bore 34 if desired. Preferably notches 42 and 44 are also machined (or otherwise formed, such as by casting or forging) to extend longitudinally along the opposite lateral sides of the bore 34.

Following finish machining, preparation is made for separating the bearing cap 25 from the main body 21. For this purpose the material, at least that in the split planes 38 and 39, must be sufficiently brittle. If the material of the connecting rod is inherently brittle, as are cast iron and some aluminium alloys, no additional preparation may be required. Less brittle materials, such as steel, may require heat treatment or selective hardening to embrittle the material sufficiently along the split planes to avoid excessive yielding when fractured. As a third possibility, ductile or insufficiently brittle materials may be made temporarily brittle for processing purposes by reducing the temperature to a sufficiently low level. This may be done for example by soaking the parts in liquid nitrogen until they reach a temperature level of −101°C (−150°F) in preparation for the fracturing step.

When the material along the split planes is, or has been made, sufficiently brittle, force-applying means are utilized to apply a separating force on opposite sides of the bore 34, acting outwardly in opposite directions parallel to the longitudinal axis 41 of the connecting rod, as shown by the arrows in Figure 4 of the drawings. The application of a separating force in this manner causes tension across the split planes extending outwardly from notches 42, 44 on opposite sides of the opening 34. The tension causes a crack 45 to progress from the edge of either one of the notches 42, 44 generally along the normal split plane 39 to the outer edge of the connecting rod,

causing fracture separation of one pair of the mating legs, in this case 24 and 28, and forming their mating ends as previously described.

If desired, the tension may be restricted to a selected one of the split planes. Other means for limiting cracking to one pair of legs may also be applied.

After cracking fracture of one pair of legs, continued force application parallel to the longitudinal axis of the connecting rod, causing further expansion of the opening 34, would cause the formation of a second crack along the split plane 38, on the opposite side of the connecting rod, and result in fully separating the cap and main body. However, uncontrolled completion of the fracture in this manner has been found to tend to cause excessive bending of the material at the outer edges of the mating legs defined by the second crack, this bending resulting in deformation of the material along the outer edge which can interfere with proper mating engagement of the cap and main body upon attempted reassembly of the two members. It is consequently advisable to provide means to prevent excessive opening of a space at the point of crack 45 which would allow the development of bending stresses in the material at the opposite split plane.

In conformity with the present invention this may be accomplished, as shown in Figure 5, by applying a clamping force on opposite ends of the initially separated legs after the crack 45 has been formed. Continued application, or re-application, of the longitudinal separating force against the cap and main body sides of the bore 34 is then effective to create a second crack 46, starting from the notch 42 and extending outwardly, generally in the split plane 38 to the outer edge of the rod, to cause fracture separation of the mating legs 22, 26 and form their mating ends.

Since the clamping force maintained against the already separated mating legs 24, 28 on the other side of the rod prevents their moving apart in a substantial degree, bending of the material at the ends of the legs 22, 26 defined by the opposite crack 46 is prevented, and the problem of yielding deformation is avoided. Thus upon assembly of the cap 25 to the main body 21, the installation of closely fitted body bolts 37 will be effective to positively re-align the members in their original positions and allow the rough projections and hollows of the opposing fractured surfaces to engage tightly and form a securely clamped assembly.

If desired, the fracture process may be accomplished with retaining bolts already loosely installed in the openings 36, to prevent full disassembly of the cap and main body and retain the parts in an assembled condition until installation of the finished part in an actual engine or other mechanism is desired. In this manner, the uniquely matched cap and rod will be maintained together in proper orientation at all times until final assembly, so reducing the possibility of assembly errors.

Figure 6 illustrates known simple force-applying means, in the form of a separating tool 48 adapted to apply the desired separating force to the opposite sides of bore 34 of the cap and main body without substantial deformation of either member. This tool 48 consists of a pair of semi-cylindrical flat-sided pressure dies 49, 50 respectively containing longitudinal grooves 52, 53 extending along their flat sides 54, 55. When the dies are placed with their flat sides together, the grooves 52, 53 co-operate to form a rectangular opening for a separating wedge 56, the grooves having oppositely angled bottoms arranged to engage angled sides 57, 58 of the wedge.

In use, the die elements 49, 50 are inserted into the opening 34 with their flat sides 54, 55 together and generally aligned with the plane 38 through the notches 42, 44. The wedge 56 is then inserted into the opening formed by the grooves, with the wedge sides 57, 58 engaging the angled bottoms of the grooves. Force is then applied to the wedge 56 so as to force the dies 49, 50 apart and apply a separating force along a major portion of the longitudinally opposed interior surfaces of the opening 34. This in turn creates the desired tension across the split planes 38, 39 to develop the cracks 45, 46.

Limitation of the opening movement of the fractured portions of the cap and body after formation of the first crack 45 separating the mating legs may be accomplished in various ways. For example, the ends of the bolt bosses in the mating legs could clamped or placed within movement-restricting jaws that prevent substantial further separation after a crack has been formed. Alternatively, the wedge 56 could be formed or moved in a manner that limits separating movement of the dies to a predetermined limited amount. In this way, bending and consequent deformation of metal at the separated leg ends of the body and cap are avoided, as previously described.

With reference now to Figures 7 to 9 of the drawings, there is shown an engine cylinder block assembly (multi bearing support), generally indicated by numeral 60, formed by a method in accordance with the present invention. The assembly 60 includes a main body 61 having, in the illustrated lower crankshaft-supporting portion, a plurality of saddle-like transverse webs 62 recessed or bifurcated to form first and second legs 63 and 64 respectively. The assembly 60 further includes a plurality of saddle-like bearing caps 66 bifurcated to form legs 67 and 68 having ends 70 and 71 that respectively engage ends 72 and 74 of the legs 63 and 64 of the assembly at each of the main transverse webs 62 of the crankcase portion.

Outwardly adjacent the legs 63 and 64, the lower surface of the crankcase (which is shown inverted) is provided with longitudinal grooves 75 and 76 that provide a break between the outer edges of the legs 63 and 64 and outer mounting surfaces 78 and 79 of the cylinder block. These grooves 75 and 76 thereby facilitate application of

the fracturing step in the method in accordance with the present invention. As in the case of the connecting rod, the caps 66 and the associated legs 63 and 64 of the webs 62 are provided with bolt openings 80 that receive shoulder bolts 82 to maintain the caps in engagement with the block upon assembly.

In manufacture, the block assembly 60 is begun by forming a block body with the bearing caps 66 integral with the webs 62. Finish machining of the block assemly 60 is then completed while the body and its individual webs 62 and associated main bearing caps 66 are integral as shown in Figure 10.

After complete machining, the caps 66 are separated from their respective webs 62 by a method in accordance with the invention, like that described with respect to the connecting rod embodiment of Figures 1 to 3. Specifically, force is applied across pin-receiving (shaft-receiving) openings 83 of all the webs simultaneously or seqentially, in directions perpendicular to the split planes inwardly defined by notches 84 and 85, and on separation of the mating legs on one side of the cap and body a clamping force is applied to prevent substantial separation of the fractured legs, while the application of separating force in the opening 83 is continued to fracture the other pair of mating legs. The result is the separated cap and web construction shown in Figure 11, which, with the addition of body bolts 82 in the bolt openings 80, may be assembled and secured in the manner illustrated in Figures 7 to 9.

Figures 12 and 12A illustrate alternative embodiments of split bearing assemblies 86, 86a respectively for supporting crankshafts or other shafts, which may be made by the method of the present invention. In each case a crankcase is constructed by placing a plurality of prefabricated bearing caps 87, 87a of one material, such as cast iron, in a mould in which main body 88, 88a of a cylinder block or crankcase is subsequently cast using another material, such as aluminium. The separate components are integrally joined together along a pre-roughened split line, and finish machining is completed in the manner previously described. Subsequently, the caps 87, 87a are separated from the main body 88, 88a using fracture separation techniques in conformity with the invention as previously described.

In the Figure 12 embodiment, the complete cap 87 is formed of one material, such as cast iron. In the embodiment of Figure 12A, a cast iron saddle portion of the cap 87a has a larger recess to receive an inner liner portion 89 of aluminium, cast with the main body and retained within the cap by projections 90 extending into recesses of the cast iron portion of the cap. Upon separation of the cap from the main body 88a, the liner portion 89 is retained within the case iron cap 87a, and is capable of acting as a bearing surface for lightly loaded shafts, for example.

Figures 13 and 14 illustrate a novel separating tool 92 for simultaneously separating the caps from the webs of a multiple-web cylinder block. The tool 92 includes a cylindrical body 93 having a longitudinal central opening 94 of rectangular cross-section intersecting longitudinally spaced laterally extending semi-circular recesses 95 in which are disposed semi-circular die members 96 having mating grooves 98. A longitudinally movable actuator 99 having a plurality of angularly disposed wedge surfaces 100 is received in the opening 94 with its wedge surfaces engaging slanted bottoms 101 of the die grooves 98.

In operation, the tool 92 is inserted through the bores or openings 83 in the webs of an integral block and cap assembly with the die members 96 positioned within the individual bearing caps. The actuating member 99 is then forced in a controlled manner in a direction such as to cause the wedge surfaces 100 to force the die members 96 outwardly, so applying separating forces to all the bearing caps simultaneously. The caps are thereby separated from their respective webs of the cylinder block using the two-step fracture separation procedure as previously described.

If required, changes may be made in the design of the components or in details of the fracture method described, and various forms of force-applying tools or fixtures could be utilized, within the scope of the following claims. Thus the force-applying tools or fixtures could comprise not just mechanical tension-applying devices but, alternatively, advanced technologies such as stress waves excited by sound, or magnetic fields, or other forms of mechanical means.

In the two-step fracture separation procedure, the clamping step may be accomplished in other ways than by applying a clamping force on the ends of the separated legs as described herein, and accordingly any procedure whereby the separated pair of legs are maintained essentially in their mated positions for the second step of the fracture separation procedure is to be considered as constituting a clamping step for the purposes of the present invention.

Claims

1. A method of making a split bearing assembly having a saddle-like main body (21) with two legs (22 and 24) and a removable saddle-like bearing cap (25) also with two legs (26 and 28) having leg ends (30 and 33) respectively secured in end-to-end mating engagement with leg ends (29 and 32) of the legs (22 and 24) of the main body (21) to define a journal-receiving opening (34), in which the main body (21) and the cap (25) are initially formed as an integral body, with their mating leg ends (29, 30, 32, 33) integrally joined, the said integral body being in a relatively brittle condition at least along generally predetermined split planes (38 and 39) lying on opposite sides of the said opening (34), the leg ends (29, 30, 32, 33) lying generally along said split planes (38, 39), and the said integral body having essentially the assembled final dimensions, with the said opening (34) being centred on an axis (40) lying within the integral body, generally between the said split

planes (38 and 39), and the cap (25) is then separated from the integral body by fracturing the integral body generally along the said split planes (38 and 39) to form the said legs of the saddle-like cap (25) and the main body (21), the legs of the cap (25) and main body (21) respectively defining two pairs of legs (22, 26 and 24, 28) matable along the split planes (38 and 39), characterised in that the fracturing step is accomplished by causing tension across the split plane (39) of one (24, 28) of the pairs of legs (24, 28 and 22, 26) to fracture and separate the leg ends (32 and 33) of the said one pair of legs (24, 28) at their respective split plane (39) while limiting relative movement of the cap (25) and main body (21) to avoid substantial bending or complete fracture of the other pair of legs (22, 26), and thereafter clamping the separated pair of legs (24, 28) in substantially their mated position and thereupon causing tension across the split plane (38) of the other pair of legs (22, 26) to fracture and separate their leg ends (29 and 30) at their split plane (38) without substantial bending, to thereby avoid bending of the legs at the split planes and yielding deformation at the leg ends and so permit mating reassembly without substantial dimensional change.

2. A method according to claim 1, characterised in that the steps of causing tension on the pairs of legs (22, 26 and 24, 28) are carried out by applying separating forces to the body (21) and cap (25) in directions normal to a plane interconnecting the split planes (38 and 39) of the two pairs of legs (22, 26 and 24, 28), the said separating forces being applied to opposite sides of the opening (34) between the legs (22, 24, 26, 28) of the body (21) and of the cap (25).

3. A method according to claim 1 or 2, characterised in that longitudinally extending notches (42 and 44) are formed across the inner edges of the split planes (38 and 39) on opposite sides of the opening (34) prior to fracturing, to initiate the fracture and positively locate the inner edges of the separated leg ends (29, 30, 32, 33).

4. A method according to any one of claims 1 to 3, characterised in that the split bearing assembly forms part of a connecting rod assembly (20).

5. A method according to any one of claims 1 to 3, characterised in that the split bearing assembly forms part of a multi-bearing support (60) for a rotatable shaft, and comprises a main body (61) as aforesaid having a plurality of saddle-like transverse webs (62) with respective bearing caps (66; 87a) as aforesaid attached to respective ones of the webs (62) to define respective journal-receiving openings (83) as aforesaid for receiving respective rotatable shafts, whereby side grooves (75 and 76) are formed in said main body (61), extending in a direction longitudinally of the webs (62), beside the bearing caps (66) and defining outer edges of the legs (63, 64, 67, 68) subject to the fracturing step.

6. A method according to claim 5, characterised in that the bearing caps (87a) comprise a saddle portion made of one material and a liner portion (89) made of a different material and extending to the split planes for the fracturing step.

7. A method according to claim 5 or 6, characterised in that, in the fracturing step, fracture separation forces are applied to the bearing caps (66) and main body (61) of the multi-bearing shaft support (60) by means of a tool (92) comprising a cylindrical body (93) having a longitudinal central opening (94) intersecting a plurality of longitudinally spaced laterally extending semi-circular recesses (95), semi-circular die members (96) disposed in the respective recesses (95) and each having an exterior surface co-operating with opposing portions of the cylindrical body (93) to define split circular ring elements, spaced longitudinally and sized to fit closely within longitudinally spaced bearing openings of the multi-bearing shaft support (60), and an actuator (99) slidably mounted in the central opening (94) and having wedge surfaces (100) engaging respective ones of the die members (96), the actuator (99) being movable longitudinally to force the die members (96) simultaneously outwardly by means of the said wedge surfaces (100) and thereby apply simultaneous separating forces to all of the bearing caps (66) and the main body (61) of the shaft support (60).

Patentansprüche

1. Verfahren zur Herstellung einer Teilungs-Lageranordnung mit einem sattelartigen Hauptkörper (21) mit zwei Schenkeln (22 und 24) und einem abnehmbaren sattelartigen Lagerdeckel (25), ebenfalls mit zwei Schenkeln (26 und 28) mit Schenkelenden (30 und 33), die jeweils in angepaßter Endanlage mit Schenkelenden (29 und 32) der Schenkel (22 und 24) des Hauptkörpers (21) befestigt sind, um eine Lagerwellen-Aufnahmeöffnung (34) zu definieren, wobei der Hauptkörper (21) und der Deckel (25) anfangs als ein Integralkörper geformt sind, dessen angepaßte Schenkelenden (29, 30, 32, 33) integral verbunden sind, wobei der Integralkörper sich zumindestens längs allgemein vorbestimmter an entgegengesetzten Seiten der Öffnung (34) liegender Teilungsebenen (38 und 39) in einem relativ spröden Zustand befindet, wobei die Schenkelenden (29, 30, 32, 33) allgemein längs der Teilungsebenen (38, 39) liegen und der Integralkörper im wesentlichen die im Zusammenbau vorhandenen Endabmessungen besitzt, die Öffnung (34) an einer innerhalb des Integralkörpers allgemein zwischen den Teilungsebenen (38 und 39) liegenden Achse zentriert ist und der Deckel (25) dann von dem Integralkörper durch Brechen des Integralkörpers allgemein längs der Teilungsebenen (38 und 39) getrennt wird, um die Schenkel des satelartigen Deckels (25) und des Hauptkörpers (21) zu bilden, die Schenkel des Deckels (25) bzw. des Hauptkörpers (21) jeweils zwei Schenkelpaare (22, 26 und 24, 28) bilden, die längs der Teilungsebenen (38 und 39) anpaßbar sind, dadurch gekennzeichnet, daß das Brechen dadurch vollendet wird, daß Zugspannung über der Teilungsebene (39) eines

Paares (24, 28) der Schenkelpaare (24, 28 und 22, 26) verursacht wird, um die Schenkelenden (32 und 33) des einen Schenkelpaares (24, 28) an ihrer jeweiligen Teilungsbene (39) zu brechen und zu trennen, während eine Relativbewegung des Deckels (25) zu dem Hauptkörper (21) begrenzt wird, um wesentliches Biegen oder vollständiges Durchbrechen des anderen Schenkelpaares (22, 26) zu vermeiden, und daß danach das getrennte Schenkelpaar (24, 28) im wesentlichen in ihrer Paßlage geklemmt wird und daraufhin Spannung über der Teilungsebene (38) des anderen Schenkelpaares (22, 26) verursacht wird, um deren Schenkelenden (29 und 30) an deren Teilungsebene (38) ohne wesentliches Biegen zu brechen und zu trennen, um dadurch ein Biegen der Schenkel an den Teilungsebenen und nachgebende Verformung an den Schenkelenden zu vermeiden und so ein passendes Wiederzusammenfügen ohne wesentliche Dimensionsänderung zuzulassen.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Verursachen von Spannung an den Schenkelpaaren (22, 26 und 24, 28) ausgeführt wird durch Anwenden von Trennkräften auf den Körper (21) und den Deckel (25) in senkrecht zu einer die Teilungsebenen (38 und 39) der zwei Schenkelpaare (22, 26 und 24, 28) verbindenden Ebene, wobei die Trennkräfte auf entgegengesetzt liegende Seiten der Öffnung (34) zwischen den Schenkeln (22, 24, 26, 28) des Körpers (21) und des Deckels (25) aufgebracht werden.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß sich in Längsrichtung erstreckende Kerben (42 und 44) über die Innenkanten der Teilungsgebenen (38 und 39) an entgegengesetzt liegenden Seiten der Öffnung (34) vor dem Brechen ausgebildet werden, um das Brechen einzuleiten und zwangsweise die Innenkanten der getrennten Schenkelenden (29, 30, 32, 33) festzulegen.

4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Teilungs-Lageranordnung einen Teil einer Verbindungsstabanordnung (20) bildet.

5. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Teilungs-Lageranordnung einen Teil einer Mehrlager-Abstützung (60) für eine Drehwelle bildet und einen Hauptkörper (21) der besagten Art mit einer Vielzahl von sattelartigen Querstegen (62) mit jeweiligen Lagerkappen (66; 87a) der besagten Art umfaßt, die an den jeweiligen Stegen (62) angebracht sind, um jeweilige Drehwellen-Aufnahmeöffnungen (83) der besagten Art zur Aufnahme jeweiliger Drehwellen zu schaffen, wodurch Seitennuten (75 und 76) in dem Hauptkörper (61) ausgebildet werden, die sich in einer Richtung längs der Stege (62) neben den Lagerkappen (66) erstrecken und dem Brechen unterworfene Außenkanten der Schenkel (63, 64, 67, 68) bestimmen.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß die Lagerkappen (87a) einen Sattelabschnitt umfassen, der aus einem Material und einer Auskleidung (89) aus einem davon unterschiedlichen Material hergestellt ist, und sich zu den Teilungsebenen für das Brechen erstreckt.

7. Verfahren nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß beim Brechen Brech-Trennkräfte auf die Lagerkappen (66) und den Hauptkörper (61) der Mehrlager-Wellenabstützung (60) übertragen werden mittels eines Werkzeuges (92), das ein zylindrisches Gehäuse (93) mit einer zentralen Längsöffnung (64) umfaßt, die eine Vielzahl von in Längsrichtung einen Abstand aufweisenden, sich quer erstreckenden halbkreisförmigen Einschnitten (95) überschneidet, wobei halbkreisförmige Formelemente (96) in den jeweiligen Einschnitten (95) angeordnet sind und jeweils eine mit gegenüberliegenden Abschnitten des zylindrischen Gehäuses (93) zusammenwirkende Außenflächen besitzen, um geteilte Kreisringelemente zu bestimmen, die in Längsrichtung Abstand aufweisen und so bemessen sind, daß sie eng in in Längsrichtung mit Abstand angeordnete Lageröffnungen der Mehrlager-Wellenabstützung (60) passen, und ein Betätigungsglied (99), das gleitbar in der Zentralöffnung (94) angeordnet ist und an jeweiligen Formelementen (96) anliegende Keilflächen (100) besitzt, wobei das Betätigungsglied (99) in Längsrichtung bewegbar ist, um die Formelemente (96) mittels der Keilflächen (100) gleichzeitig nach außen zu drängen und dadurch gleichzeitige Trennkräfte auf alle die Lagerkappen (66) und die Hauptkörper (61) der Wellenabstützung (60) anzuwenden.

Revendications

1. Procédé de fabrication d'un palier en plusieurs pièces ayant un corps principal (21) en forme de selle qui a deux branches (22 et 24) et un chapeau amovible de palier (25) en forme de selle qui a aussi deux branches (26 et 28) ayant des extrémités (30 et 33) qui sont fixées respectivement bout à bout sous forme complémentaire aux extrémités (29 et 32) des branches (22 et 24) du corps principal (21) de manière qu'une ouverture (34) de logement d'un tourillon soit délimitée, dans lequel le corps principal (21) et le chapeau (25) sont formés initialement d'un corps en une seule pièce, leurs extrémités complémentaires de branches (39, 30, 32, 33) étant reccordées en une seule pièce, le corps en une seule pièce étant à un état relativement fragile au moins le long de plans (38 et 39) de séparation qui sont prédéterminés de façon générale, ces plans étant disposés de part et d'autre de l'ouverture (34), les extrémités (29, 30, 32, 33) des branches étant disposées de façon générale le long des plans de séparation (38, 39), et le corps en une seule pièce ayant pratiquement les dimensions finales montées, ladite ouverture (34) étant centrée sur un axe (40) disposé dans le corps en une seule pièce, entre les plans de séparation (38 et 39) de façon générale, et le chapeau (25) est séparé du corps en une seule pièce par fracturation du corps en une seule pièce suivant les plans de séparation (38 et 39) de façon générale afin que les branches

du chapeau (25) en forme de selle et du corps principal (21) soient formées, les branches du chapeau (25) et du corps principal (21) délimitant respectivement deux paires de branches (22, 26 et 24, 28) qui peuvent coopérer sous forme complémentaire le long des plans de séparation (38 et 39), caractérisé en ce que l'étape de fracturation est réalisée par création d'une tension dans le plan de séparation (39) de l'une (24, 28) des paires de branches (24, 28 et 22, 26) afin que les extrémités (32 et 33) de la première paire de branches (24, 28) soient fracturées et séparées dans leurs plans respectifs de séparation (39) avec limitation du déplacement relatif du chapeau (25) et du corps principal (21) de manière qu'un fléchissement notable ou une fracture complète de l'autre paire de branches (22, 26) soit évité, puis le serrage de la paire de branches séparées (24, 28) pratiquement dans leurs positions complémentaires de coopération puis la création d'une tension dans le plan de séparation (38) de l'autre paire de branches (22, 26) afin que les extrémités (29 et 30) des branches soient fracturées et séparées dans leur plan de séparation (38) sans fléchissement notable, si bien que le fléchissement des branches dans les plans de séparation et la déformation par fléchissement au niveau des extrémités des branches sont évités, et le remontage complémentaire est permis sans modifications dimensionnelles notables.

2. Procédé selon la revendication 1, caractérisé en ce que les étapes de création d'une tension dans les paires de branches (22, 26 et 24, 28) sont mises en oeuvre par application de forces de séparation au corps (21) et au chapeau (25) en direction perpendiculaire à un plan reliant les plans de séparation (38 et 39) des deux paires de branches (22, 26 et 24, 28), lesdites forces de séparation étant appliquées aux côtés opposés de l'ouverture (34) entre les branches (22, 24, 26, 28) du corps (21) et du chapeau (25).

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que des encoches disposées longitudinalement (42 et 44) sont formées aux bords internes des plans de séparation (38 et 39) de part et d'autre de l'ouverture (34) avant la fracturation, afin que la fracture soit amorcée et que les bords internes des extrémités des branches séparées (29, 30, 32, 33) soient positionnés positivement.

4. Procédé selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le palier en plusieurs pièces fait partie d'une bielle (20).

5. Procédé selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le palier fendu fait partie d'un support (60) d'un arbre rotatif ayant plusieurs paliers, et comporte un corps principal (61) tel qu'indiqué précédemment ayant plusieurs joues transversales (62) en forme de selle comportant des capuchons respectifs de paliers (66; 87a) tels que définis précédemment, fixés aux joues respectives (62) afin que des ouvertures respectives (83) de logement de tourillons soient formées comme indiqué précédemment pour le logement d'arbres rotatifs respectifs, si bien que des gorges latérales (75 et 76) sont formées dans le corps principal (61) en direction de la longueur des joues (62), à côté des chapeaux de paliers (66), et délimitent les bords externes des branches (63, 64, 67, 68) soumises à l'étape de fracturation.

6. Procédé selon la revendication 5, caractérisé en ce que les chapeaux de paliers (87a) comportent une partie en forme de selle formée d'un matériau et une partie (89) de revêtement formée d'un matériau différent et disposée jusqu'aux plans de séparation formées dans l'étape de fracturation.

7. Procédé selon la revendication 5 ou 6, caractérise en ce que, pendant l'étape de fracturation, des forces de séparation par fracture sont appliquées aux chapeaux (66) de paliers et au corps principal (61) du support (60) d'arbre à plusieurs paliers à l'aide d'un outil (92) qui comporte un corps cylindrique (93) ayant une ouverture longitudinale centrale (94) recoupant plusieurs cavités semi-circulaires (95) dépassant latéralement et espacées longitudinalement, des organes semi-circulaires de matrice (96) disposés dans les cavités respectives (95) et ayant chacun une surface externe coopérant avec des parties opposées du corps cylindrique (93) afin que des éléments circulaires fendus soient délimités, ces éléments étant espacés suivant la longueur et ayant des dimensions telles qu'ils s'ajustent dans les ouvertures de paliers espacées longitudinalement dans le support (60) à plusieurs paliers, et un organe (99) de manoeuvre monté dans l'ouverture centrale (94) de manière qu'il puisse coulisser et ayant des surfaces (100) de coin coopérant avec les organes respectifs de matrice (96), l'organe de manoeuvre (99) étant mobile longitudinalement afin qu'il chasse simultanément les organes de matrice (96) vers l'extérieur par l'intermédiaire des surfaces de coin (100) et applique ainsi des forces simultanées de séparation à tous les chapeaux de paliers (66) et au corps principal (61) du support (60) d'arbre.

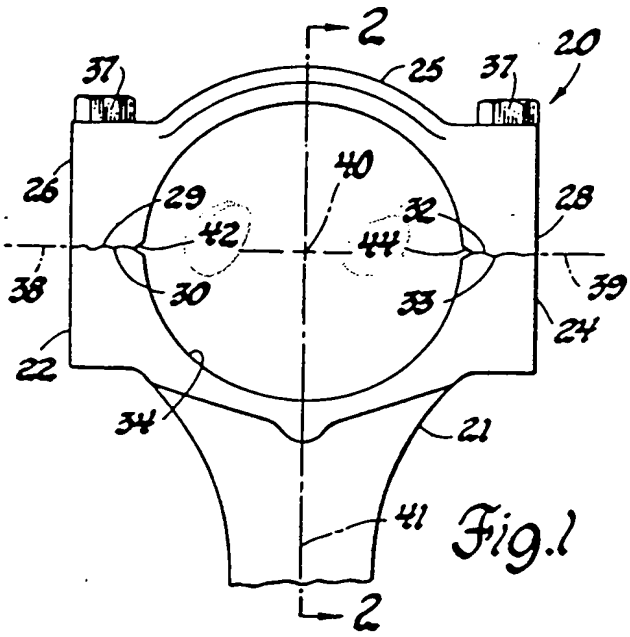

Fig.1

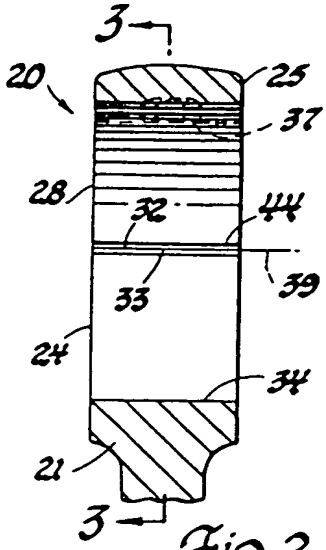

Fig.2

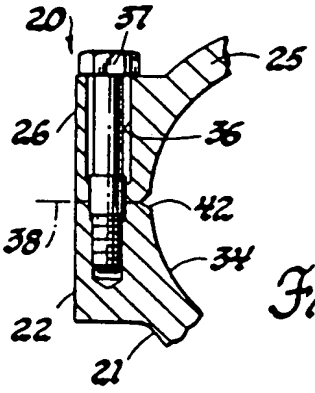

Fig.3

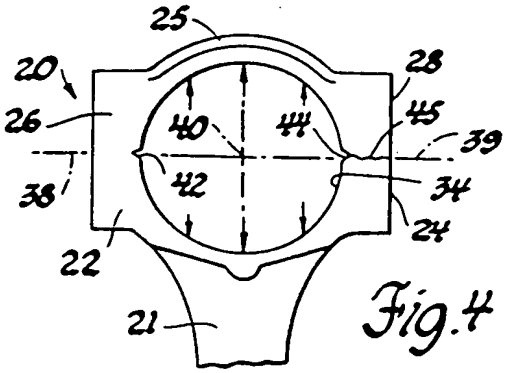

Fig.4

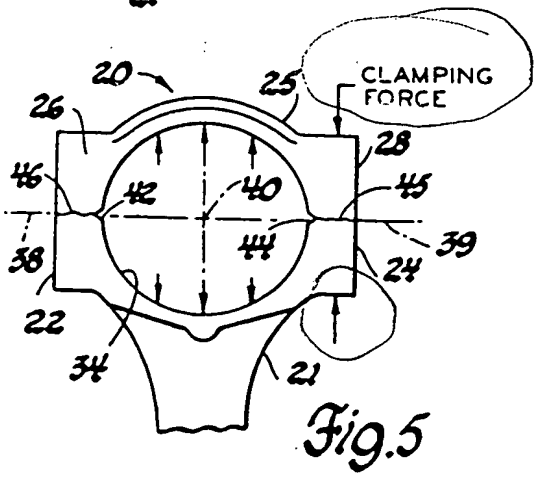

Fig.5

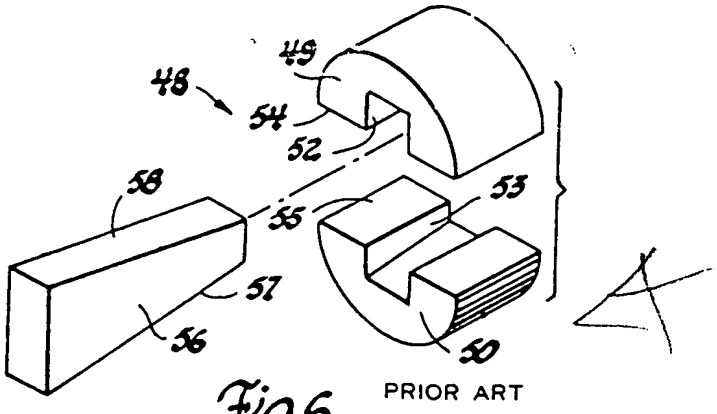

Fig.6

PRIOR ART

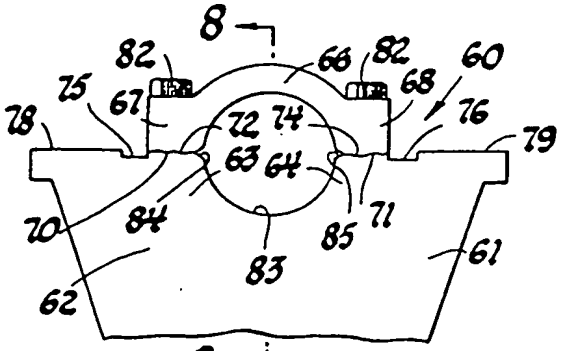

Fig.7

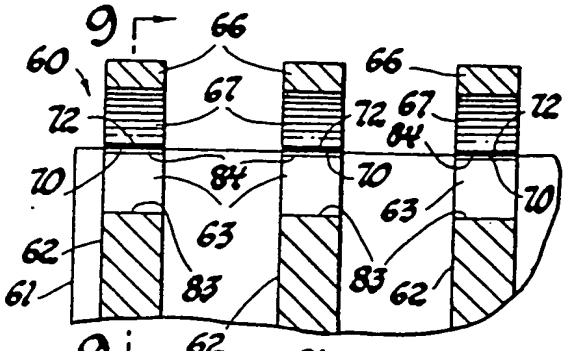

Fig.8

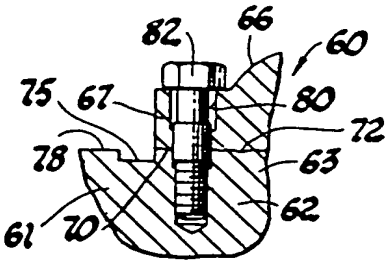

Fig.9

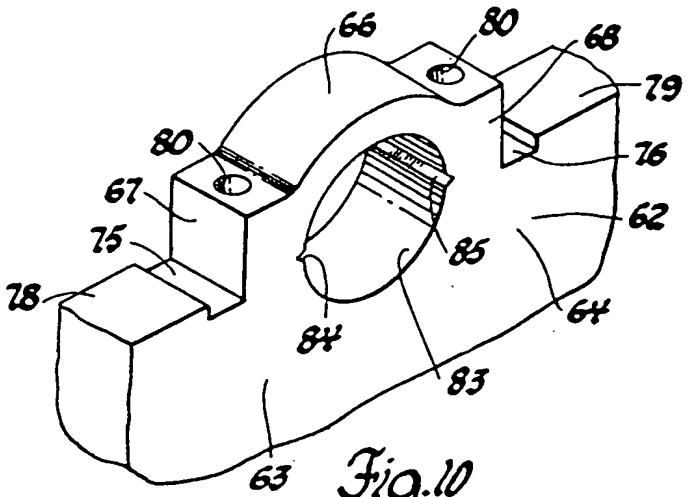

Fig.10

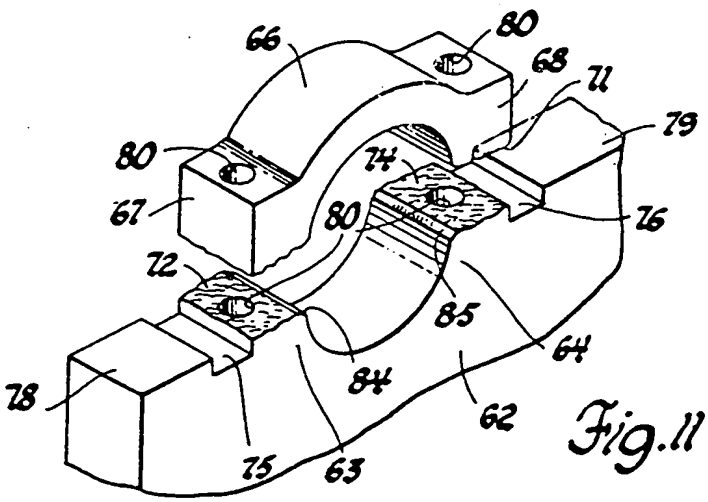

Fig.11

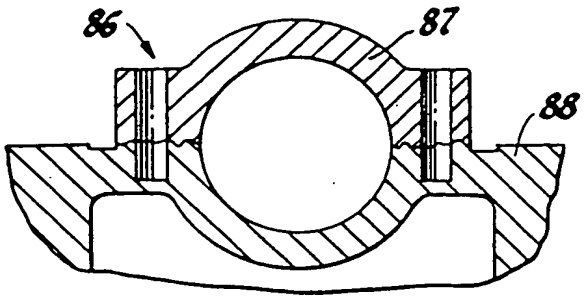

Fig.12

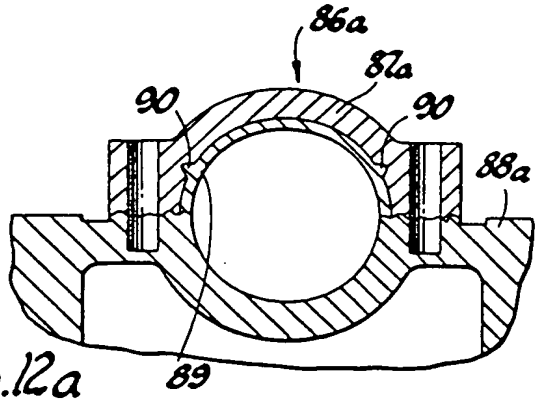

Fig.12a

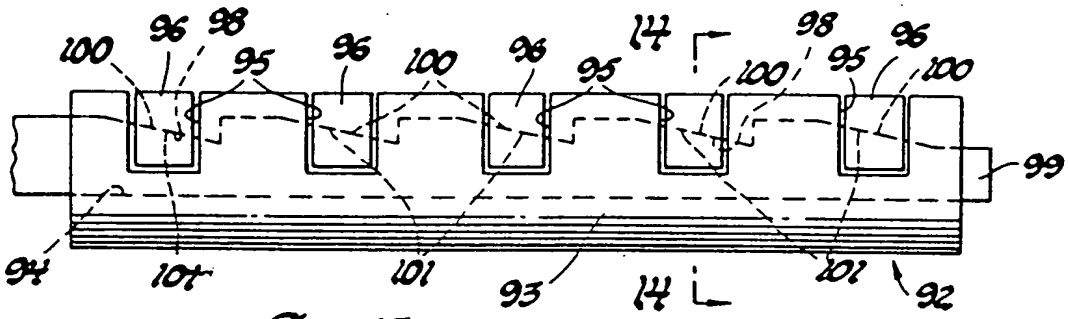

Fig.13

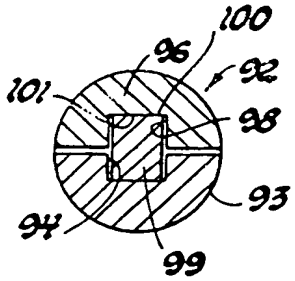

Fig.14